A Look at Consecutive Days with Below Normal Average Temperatures

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Amarillo recently experienced 11 days in a row of daily average temperatures that were below normal. The question is, "How unusual is this streak?"

Using Amarillo's daily temperature data back to January 1, 1991, I looked at the occurrences of consecutive days with below normal daily averages. The winner is 24 consecutive days, which occurred from January 12, 2007 to February 4, 2007. We will probably not challenge that record any time soon.

The data (1991 through 2015) are summarized in the following table. The relative frequencies are the individual frequencies divided by the total of all the frequencies (1211).

Consecutive Days Below Normal	Frequency	Relative Frequency
1	385	0.317919
2	279	0.230388
3	184	0.151941
4	108	0.089182
5	81	0.066887
6	56	0.046243
7	47	0.038811
8	25	0.020644
9	17	0.014038
10	7	0.005780
11	3	0.002477
12	4	0.003303
13	5	0.004129
14	3	0.002477
15	3	0.002477
16	1	0.000826
17	0	0
18	1	0.000826
19	0	0
20	0	0
21	0	0
22	1	0.000826
23	0	0
24	1	0.000826

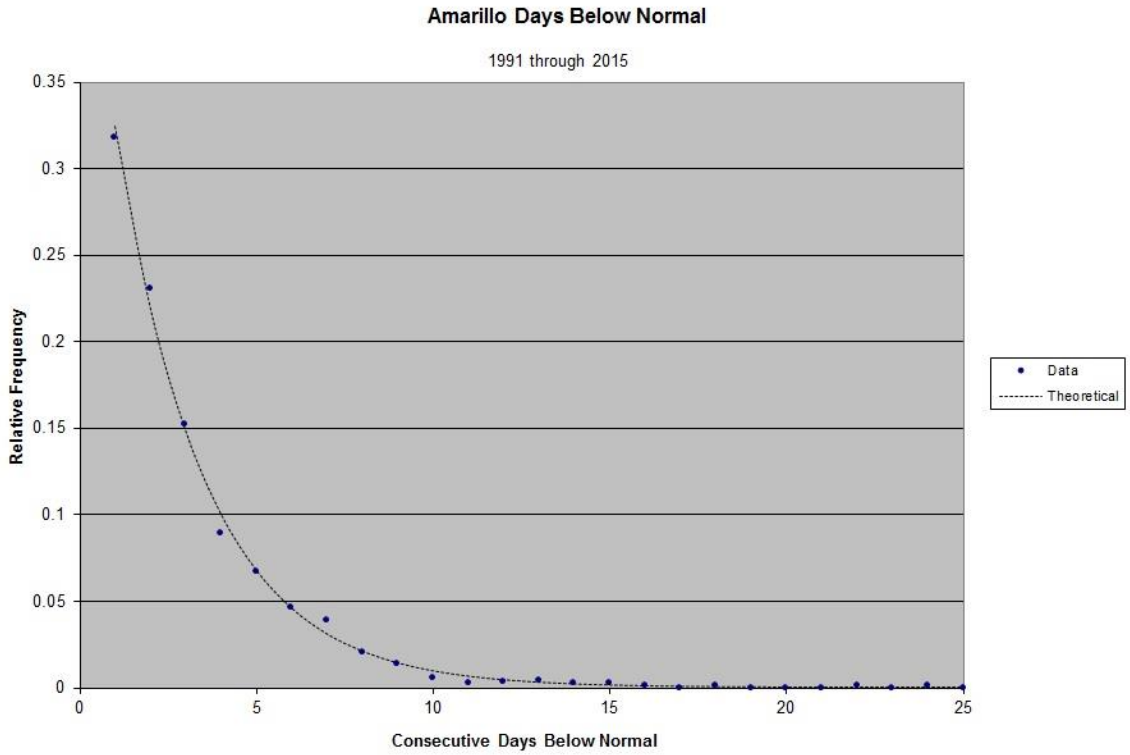
As seen in the table, a streak of 11 consecutive days is rather unusual, since it occurred only three times in 25 years.

Statistical theory suggests that data of this type should follow a geometric distribution. The probability density function is given by

$$p(n) = \left(1 - \frac{1}{\mu}\right)^{n-1} \left(\frac{1}{\mu}\right)$$

where *n* is the number of consecutive days with below normal average temperatures, and μ is the mean or average number of consecutive days below normal. The mean of this data set is 3.082576 days.

As seen in the following graph of relative frequency versus consecutive days, the theoretical curve is a good fit to the data.



As more data are gathered, the model will probably fit even better.

Note: I used Amarillo's climate normal data for the 30-year window from 1961 through 1990 as my standard. The current climate normal data have been updated twice since then, with the current window being 1981 through 2010. I wanted my analysis to be based on a fixed standard.